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(54) Title: PREPARATION PROCESS OF PAPER FOR INCREASING FILLER CONTENTS AND ENHANCING SCOTT INTERNAL BOND STRENGTH

## (57) Abstract

Disclosed is a preparation process of paper for increasing the contents of the inorganic fillers in the paper and enhancing Scott internal bond strength. Additional to a conventional preparation process of paper, as a cellulase type enzyme, an enzyme produced by *Trichoderma longibrachiatum* which has a carboxymethylcellulase activity of 3,600 U/ml or more is added to a pulp in an amount of 0.01 ~ 0.2 % by weight based on the weight of the wood pulp. The contents of fillers in the paper is increased and Scott internal bond strength is enhanced.

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PREPARATION PROCESS OF PAPER FOR INCREASING FILLER CONTENTS  
AND ENHANCING SCOTT INTERNAL BOND STRENGTH

Technical Field

The present invention relates to a preparation process of a paper for increasing the contents of inorganic fillers in the paper while maintaining the internal bond strength of the paper. The present invention further relates to a preparation process of paper wherein a wood pulp is treated with a cellulase-type enzyme for beating to thereby improve the paper strength, particularly the internal bond strength so that the filler contents of paper can be increased as much as the increased amount of the internal bond strength. As a result a paper having a large amount of fillers while maintaining an internal bond strength thereof can be prepared.

15 Background Art

Generally, a printing paper is prepared by mixing a beaten wood pulp with inorganic fillers and then adding at least one cohesive agent. As a fillers for paper production, talc, calcium carbonate, titanium dioxide etc. can be used.

20 A portion of pulp can be replaced with a filler to save the production cost of the paper and the brightness, the opacity, the smoothness and printability of the paper can be improved. Therefore, addition of a filler into paper is preferable.

However, when a large amount of a filler is added into the pulp, since the fillers weaken the intermolecular binding force of the pulp, the physical and mechanical properties of the pulp deteriorate. Further, during the drainage process of the pulp fibers on the wires of a paper machine, the fillers pass through the wires and the fillers retention in paper decreases. The wires are severely abraded and therefore the load for circulation of white water and water drain is increased, which is unpreferable.

Disclosure of the Invention

Therefore, it is an objective of the present invention to provide a preparation process of paper wherein the contents of the inorganic fillers included in the paper is increased while main-

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-taining the internal bond strength thereof.

In accordance with the present invention, a cellulase-type enzyme is added to a pulper and the pulp is disintegrated. Then, this pulp is treated for beating and processed for paper making.

5 At this time, due to an activity of the cellulase type enzyme on the pulp fiber, the surface area of the fiber is increased. As a result, the bond force between the fibers is increased to thereby enhance the internal bond force of the paper.

#### Best Modes for carrying out the invention

10 In accordance with a preparation process of paper, a cellulase-type enzyme is added to a pulper to dissolve the pulp and then the pulp is beaten for a preparation of paper.

The cellulase type enzyme is added to the pulper in amount of 0.01 ~ 0.2% by weight based on the weight of the wood pulp, 15 thereby disintegrating the wood pulp and then beating the wood pulp. At this time, as a cellulase type enzyme, an enzyme produced by *Trichoderma longibrachiatum* which has a carboxymethyl-cellulose activity of 3,600U/ml or more, is preferably used.

When the beaten wood pulp is processed for the preparation 20 of paper in the same manner as a conventional process, the cellulase-type enzyme activates the surface of the pulp fiber of thereby increase the surface area of the fiber. Therefore, the binding between the fibers is improved to increase the internal bond strength of paper. Therefore, the contents of the filler 25 can be increased as much as the increased amount of the internal binding force.

The preparation process of paper according to the present invention will be explained in detail hereinafter.

Bleached chemical wood pulp and 0.01 ~ 0.2% by weight(based 30 on the weight of the wood pulp)of a cellulase type enzyme having a carboxymethylcellulase activity of 3,600U/ml or more are simultaneously introduced into a pulper. At this time, the dissolving temperature is maintained between 35 ~ 45°C and pH of 4.0 ~ 6.8.

35 Under these conditions, the pulp is disintegrated for 15 ~ 20 minutes and then beaten using a refiner so as to have a suit-

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ble beating degree. The pulp stock thus prepared in this manner is transferred to the paper machine for paper making. The cellulase type enzyme activates the surface of the pulp fiber to increase the surface area of the fiber. As a result, the strength of paper, especially the internal bond strength is remarkably increased.

In a conventional process, a large amount of fillers can not be included in the paper since the fillers deteriorate the physical properties of the paper. However, in the present invention, due to the using an enzymatic treatment, the internal bond strength is increased and therefore the contents of fillers may be increased as much as the increased amount of the internal bond strength.

The paper prepared in accordance with the present invention as explained above has following properties when compared with that prepared in accordance with a conventional process.

①The beating power consumption of can be reduced.

②When having the same amount of fillers, the internal bond strength is improved.

③When having the same internal bond strength, the absolute contents of fillers can be increased by up to 5% by weight.

④As a large amount of fillers is included in the paper, the drying power consumption of the paper can be reduced.

Hereinafter, the present invention will be explained in detail with reference to the following examples.

#### Example 1

A pulp stock was prepared to have the composition as shown in table I as below.

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Table 1

	Components	Composition rate (% by weight)
5	Bleached chemical pulp of needle-leaf trees	85
	Bleached chemical pulp of broad-leaf trees	15
10	Retention enhancing agent	Cationic polyacrylamide
15	Fillers	0.05 *
		Calcium carbonate
		15 **
		Talc
		15 **
15	Paper strength enhancing agent	Positive starch
		0.5 *

\* Composition ratio based on the weight of the produced paper.

\*\* Composition ratio based on the weight of the pulp.

Using the composition ratio as shown in table 1, as a cellulase-type enzyme an enzyme produced by *Trichoderma longibrachiatum* having a carboxymethyl-cellulase activity of 3,600U/ml or more was introduced into a pulper in an amount of 0.02% by weight based on the pulp while maintaining a temperature of about 40°C and pH of 4.0 ~ 6.8.

Under the above conditions, after dissolving the pulp stock for 15 minutes, the pulp stock was beaten to a predetermined beating degree, to prepare a hand sheet having 80g/m<sup>2</sup> basis weight, which was conditioned at a constant humidity of 49 ~ 51% and at a temperature of 22 ~ 24°C. Thereafter, ash contents and Scott internal bond strength of the paper were measured.

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The results are shown in Table 2.

**Comparative Example 1**

In order to compare the preparation process of paper according to the present invention and a conventional preparation process of paper, a paper was prepared in the same manner as in Example 1 except that an enzyme was not introduced into the pulper. Ash contents and Scott internal bond strength of the paper were measured. The results are shown in Table 2.

**Example 2**

10 A paper was prepared in the same manner as in Example 1 except that the enzyme was introduced in the pulper in an amount of 0.1% by weight. Ash contents and Scott internal bond strength were measured and the results are shown in Table 2.

**Example 3**

15 A paper was prepared in the same manner as in Example 1 except that the enzyme was introduced in the pulper in an amount of 0.2% by weight. Ash contents and Scott internal bond strength were measured and the results are shown in Table 2.

**Example 4**

20 A paper was prepared in the same manner as in Example 1 except that the enzyme was introduced into the pulper in an amount of 0.1% by weight and that calcium carbonate and talc were added in an amount of 20% each by weight respectively. Ash contents and Scott internal bond strength were measured. The 25 results are shown in Table 2.

Table 2

	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Comparative Example 1
Ash contents (% by weight)	20.2	20.3	20.3	24.9	20.1
Scott internal bond strength	149	167	173	135	134

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As can be seen from the above, the paper prepared according to the present invention has an increased internal bond strength at the same amount of ash contents when compared to a paper prepared according to a conventional process. Further, Scott 5 internal bond strength is remained at the same level as the conventional process in spite of an increased amount of inorganic fillers.

Therefore, the paper prepared according to the present invention maintains an internal binding strength which is one of 10 most important characteristics for a coating base paper, a printing paper and a photocopy paper in spite of an increased amount of an inorganic filler contained in the paper. Further, as the amount of the enzyme is increased, the internal bond strength is enhanced. The amount of a pulp material can be saved 15 as much as the increased amount of the fillers.

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Claims

1. A preparation process of a paper containing an inorganic filler for a base paper of coating paper a printing paper and a copying paper characterized in that an cellulase type enzyme is added to a paper material having said inorganic filler in a 5 pulper so that a content of the inorganic filler is increased and an internal bond strength of the paper is enhanced.
2. The preparation process as claimed in claim 1, wherein said cellulase type enzyme is a *Trichoderma* species.
3. The preparation process as claimed in claim 2, wherein 10 said cellulase type enzyme is an enzyme having a carboxymethyl-cellulase activity of 3,600U/ml or more produced by *Trichoderma longibrachiatum*.
4. The preparation process as claimed in claim 1, wherein said cellulase type enzyme is added in an amount of 0.01 ~ 0.2% 15 by weight based on a weight of wood pulp.
5. The preparation process as claimed in claim 1, wherein said inorganic filler is at least one selected from the group consisting of talc, calcium carbonate and titanium dioxide.
6. The preparation process as claimed in claim 1, wherein 20 said inorganic filler is contained in an amount of 30 ~ 40% by weight.

**Sorry, there are no drawings for patent number 2187757.**

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